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CD NO.

DATE OF INFORMATION 1948

DATE DIST. 31 May 1950

NO. OF PAGES 9

SUPPLEMENT TO
REPORT NO.

SUPPLEMENT TO
REPORT NO.

SUPPLEMENT TO
REPORT NO.

THIS IS UNEVALUATED INFORMATION

SOURCE Olearia (Vegetable Oils), Vol III, No 1, 1949.

CULTIVATION OF OLEAGINOUS PLANTS IN THE USSR

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The author reviews the principal oil plants and trees cultivated in the USSR, examining production data and characteristic features of cultivation. As a result of the postwar agricultural and industrial revival, the output of vegetable oils in 1948 is expected to amount to 675,000 metric tons, a figure slightly below the prewar average. Though the supply is not yet sufficient to cover domestic demand, the author is of the opinion that when the present Five-Year Plan is completed there is likely to be an exportable surplus of vegetable oils that may have a permanent effect on the world market situation.

Vegetable oils account for half of the total fat output of the USSR, while Soviet production of fats amounts to 6 percent of the total world output. Since definite figures for the last few years are lacking, it is only possible to estimate the USSR's total annual output of vegetable oils. An estimate based on available, but incomplete statistics gives a minimum of 500,000 metric tons annual output. In 1940, just prior to the war, annual output had risen to 705,000 metric tons. Considering the present output, the planned output of the current Five-Year Plan, which is set at 880,000 metric tons by 1950, does not seem unreasonable.

The vastness of the territory and the variety of ecological conditions, from the Arctic Circle to the subtropical belt of the Transcaucasus and Turkestan, form the basis for the widespread and varied production of oleaginous plants. However, the possibilities for production of oleaginous plants remained latent until after World War I. At that time, many previously unknown crops were introduced. These crops included the soybean, the peanut, the castor oil plant, the perilla, the lallemantia, the tung tree, etc. The Institute of Scientific

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Research for Oleaginous Plants was founded, and today has the right to control and approve the plants to be raised by local populations. Much has been done to improve agricultural techniques, and all operations, from the sowing of the seed to the final extraction of the oil, have been mechanized. Furthermore, the methods now in use can be improved.

In 1947, 3,738,400 hectares were put into oleiferous plants (excluding the oleaginous textile plants), with most of this area located in the south-central regions of the Soviet Union, which are especially adapted to these crops because of their warm climate and long growing season. However, there is insufficient rainfall over a very wide area, and the irrigation net is at present not extensive enough to meet all agricultural needs. Even if agriculture is further industrialized, it will still be widely dispersed in these regions and the yield will remain low. Another bad feature of steppe agriculture is the lack of an agricultural tradition among the indigenous population, which has been nomadic for many centuries. Among the many regions in the USSR where oleaginous plants are grown are some localities famous for their natural advantages and for the technical progress of their workers. These localities show the real potentiality of production, which is today still insufficient to meet domestic requirements, but which may, in the not too distant future, be increased to the point where large-scale exports could be sustained.

Sunflowers

The sunflower is the most important oleaginous crop in the USSR from the standpoints of distribution and quantity of production. It appeared in Russia toward the middle of the 18th Century, first in the Ukraine, then along the Volga, and was initially considered (as elsewhere in Europe) a decorative plant. Subsequently, the toasted seeds were eaten as confections. The first experiments in extracting oil from the sunflower were made at the beginning of the last century. Even today, the cultivated varieties are separated into seed and oil types, and other varieties which are less utilized are separated into forage types, including the annual *Helianthus annuus cultus*, *austroruthenicus* Wenzl, and the perennials *H. Maximiliani*, *orgyalis*, etc. The most valuable oil varieties are those which have tough "plating" over the seed integument in the form of specially pigmented tissues which provide complete immunity to the sunflower weevil. Several varieties, resistant to dodder (which is difficult to control on asteraceous fields), have been developed, but do not as yet meet the requirements for high productivity.

Work on genetic improvement, which has been developing continuously during the last 20 years, has greatly benefited sunflower oil seed crops through the introduction of numerous select strains, several of them since the end of World War II. After 35 years of uninterrupted work, A. Krasnodar and P. Pustovoi recently developed several varieties which, under suitable conditions, exceed the oil content of the standard varieties. (The author has done experimental work in Italy on the standard variety 8281 Zhdanov.) In 1945, the new varieties, designated No 1483, 1647, 3519, 4036, etc., were grown on more than 200,000 hectares in field-size units. Varieties 4966 and 6540 were introduced on a smaller scale. Variety 6540 has exceeded oil production figures of variety 8281 by 24 percent per hectare. The oil content is that of the best varieties previously known and varies from 43-44 to 52-57 percent, in comparison to shelled almonds.

There have also been improvements in agricultural technology. Seed has been propagated by means of Benkovskiy's apparatus, a system which permits savings in seed and manpower, especially in weeding. Zmiyevskiy has perfected a sunflower harvesting and threshing combine. A means of artificial pollination, similar to the system used for maize, has been developed, and, over an

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area of 240,000 hectares, has increased production 100 to 300 kilograms per hectare. Average Soviet unit production in 1940 was 930 kilograms per hectare, with certain growing regions (Krasnodar, northern Caucasus) averaging 1,500-1,650 kilograms per hectare. A few localities have even produced as much as 3,400-5,000 kilograms per hectare. During World War II, the unit average for the Soviet Union dropped to barely 300 kilograms per hectare. In the postwar period, Soviet agriculture has been able, for the most part, to restore the prewar level of production, even exceeding the 4,000 kilograms per hectare which made Saratov famous.

In 1939, 3,346,000 hectares were in sunflower. In 1941, with 85 percent of the total world sunflower acreage, the Soviet Union produced 60 percent of the world sunflower output. In 1947, after the very sharp reduction in acreage of the 5 previous years, the area in sunflower rose to 2,754,500 hectares, with an average yield of 790 kilograms per hectare, or a total production of 2,176,000 metric tons. The output was 79 percent greater in 1947 than in 1946, which has been a disastrous year for oleaginous plants because of the unexpected drought. In 1948, the area in sunflower was expanded to 3,392,000 hectares, and indications are that the 1949 output will exceed the 1948 total both quantitatively and qualitatively. The Five-Year Plan calls for 3,700,000 hectares, with an average yield of 1,000 kilograms per hectare, to be placed in sunflower by 1950. Ukrainian SSR leads with 60 percent of the total Soviet output, it is followed by Krasnodar and Stavropol krais, Grozny Oblast, the Crimea, the central regions (Voronezh Oblast, the Middle Volga), Kabardinian and Dagestan ASSR, as well as eastern and central Siberia.

Production of cottonseed in the southernmost belt of the Soviet Union and of linseed and hempseed in more northerly regions follows sunflower seed production in importance.

Cotton

The cotton plant, which prior to 1917 was grown only in a narrow zone of the Transcaucasus, has become, in the last 20 years, the most important textile plant in the Soviet Union. The USSR is now second only to India as the world's leading producer of raw cotton and cottonseed oil. Cultivation of the cotton plant is now distributed through Central Asia, the Transcaucasus, Dagestan ASSR, the Crimea, and Ukrainian SSR. In the period 1934 - 1938, there were 2 million hectares in cotton, with a total annual output of 1,424,000 metric tons of cottonseed. By 1940, cottonseed production had risen to 1,900,000 metric tons, four times the 1913 output. As in the case of sunflowers, the increases attained in cottonseed production are due to extensive work on improving breeds, conducted over an area of 137,000 hectares, utilizing local, American, and Egyptian varieties. The improved strains include the following short-fiber varieties: Schraeder 1306 (from Turkestan), Akgiura 182, Deccan 169, No 4495, 3751, and 143 U. Long-fiber varieties represent 77 percent of the total production and include Tashkent 1838, 491, 10032, 2017, the Trionfo (possibly Pobeda or Triumph-Victory) of Navroskiy, etc. Development of irrigation canals in the Aral depression has contributed to a general unit increase in production (the irrigated crops average 1,600-2,000 kilograms per hectare) and has also kept down the danger of recurring droughts. As a result of a drought, the 1946 production was 21 percent below the subsequent 1947 production, which, in turn, was still below normal. In 1947, 1,467,000 hectares were in cotton. This acreage rose in 1948 to 1,530,000 hectares. The 1950 goal is 3,100,000 metric tons of raw cotton and about 2 million metric tons of seeds. These figures are higher than the prewar level.

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Flax

During the war, flax production fell off sharply because the territory occupied by the Germans was completely nonproductive. Although flax production has increased since the end of the war, by 1946 only half the 1940 acreage of 2 million hectares was under cultivation. In 1933, there were 2,730,000 hectares in flax. The average for the years 1934 - 1938 was 2,351,000 hectares, with a yield of 773,000 metric tons of seed. Despite the drop in output, the Soviet Union today remains the world's leading producer of flax. Although linseed declined in importance in the period preceding the war, the continuing importance of flax fiber has maintained Soviet production of flax and, consequently, of linseed at a high level, fluctuating between 570,000 and 840,000 metric tons a year and making the Soviet Union the world's second greatest producer of oleaginous linseed. The area most adapted to the cultivation of flax takes in all of central and southern European Russia and central Asia. At present, there is a tendency to concentrate the cultivation of flax in Stavropol Kray and in the Uzbek and Tadzhik republics, and to favor varieties most adaptable to these areas.

Experimental work in selective breeding has resulted in the development of several equally valuable strains, among which the most important are: the Afghana 1308/138, the Kagalniskiy 1531, the Americana 265, the Sibiryak DSO-166, the Stavropol 79, the VIR-1647, 1650, and 1658. The oil content averages about 39.5 percent. The specialized cultivation of flax for seed has again been increasing in the last 3 years, with the following areas under cultivation: 1946, 198,000 hectares; 1947, 238,000 hectares; and 1948, 336,000 hectares. The overall yield for 1950 is set at 300,000 metric tons of seed (which includes seed obtained from plants raised primarily for their fiber).

Hemp

Extended cultivation of hemp as a fiber plant (625,000-650,000 hectares in the prewar period) has made the USSR the world's leading producer of both hemp fiber and hempseed. Hempseed production from 1934 to 1938 averaged 25,100 metric tons per year. Hemp is cultivated throughout the Soviet Union, but most intensively in the western Ukraine, in the central region to the Volga, and in western Siberia.

The area in hemp declined during the war for the same reasons as flax, but the acreage is now increasing again. There were 229,000 hectares in hemp in 1946. The 1947 total of 337,000 hectares is slightly more than half the prewar figure. Production of seed is continuing at the same level and will probably not exceed 12,500 metric tons per year. The plan had set 506,000 hectares of hemp as the 1948 goal.

Crucifer (Mustard Family)

Crucifer is the most important of the so-called minor crops (minor in area rather than importance), and its cultivation is traditional in the USSR, even though the output is small. Mustard seed, species *Brassica juncea*, variety *sareptana* (*hirsuta*), and species *Sinapis alba*, are more widespread than other cruciferous plants. *Brassica juncea* is found in Belorussian SSR, southeastern Russia, Kazakh SSR, Central Asia, and elsewhere and includes four distinct geographical groups and nine ecological types with an oil content varying from 31 to 42 percent. Experimental work has developed the varieties 189/191, 260/1407, and, more recently, variety No 2 which is not easily husked. Unit production varies from 530 to 1,200 kilograms per hectare. *Sinapis alba*, which is cultivated throughout the Soviet Union up to 62-65 degrees north latitude and even in more humid zones, has a high unit output, averaging 1,200 kilograms per hectare (ranging from a minimum of 360 to a maximum of 1,700 kilograms per

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hectare), with an average oil content of 22-25 percent. Selection has isolated the varieties 98, 162, and Lunin. The two species of mustard seed plants covered 277,000 hectares in 1947. In 1948, 290,000 hectares yielded 200,000 metric tons of seeds.

Colza and rape are cultivated on a smaller scale, depending on the climate, the terrain, and the care given to the plants. Colza is localized in the southern belt of the USSR, where 97 percent of the total acreage is found. In 1937, colza covered a total area of 65,800 hectares, with an average unit yield of 1,050 to 1,600 kilograms per hectare. In individual localities the yield has frequently exceeded 1,800-2,100 kilograms per hectare and has even reached 3,750 kilograms per hectare. Despite its good qualities, colza has not been grown much beyond the borders of the western Ukraine because of the severity of the climate. Work on selection has centered on the development of cold-resistant and easily husked strains. The oil content is 45.2 percent in the autumn varieties and 34.6 percent in the spring varieties. The actual production total is not known, but probably does not exceed 50,000 metric tons.

The rape, which is cultivated on a very small scale, is superior to both colza and mustard because it can be easily husked.

Among other crucifers indigenous to the Soviet Union, *Sinapis nigra*, *Coringia orientalis*, *Eruca sativa*, etc., are not utilized commercially. Because of its extreme adaptability, camelina was the only oleiferous plant, acreage of which increased during the war, expanding from 102,000 hectares in 1940 to 259,000 hectares in 1945. Camelina's greatest expansion took place in Kazakh SSR and Bashkir and Buryat-Mongol ASSR, more backward agricultural areas. Camelina's natural adaptability and its great resistance to cold and drought compensate, to some extent, for its low productivity (an average unit yield of 500-600 kilograms per hectare with a maximum yield of 1,100 kilograms per hectare). Two species of camelina are known: *Camelina sativa* (gold of pleasure), a spring variety, and *Camelina pilosa*, an autumn variety. (*Camelina linicola* must be distinguished from these species since it is a species of flax). The oil content of camelina is not negligible, varying from 23 to 44.5 percent. In 1947, there were 227,400 hectares in camelina; seed yield is about 100,000 metric tons.

Poppy

Poppy is a traditional oleiferous plant in the USSR, and its cultivation, while not extensive, is still important. Of the eight species and 20 varieties found in the USSR, *Papaver somniferum* is most extensive, especially in the Ukrainian, Belorussian, Kazakh, and Kirgiz SSR, Voronezh, Kuybyshev, Novosibirsk, and Omsk oblasts, Krasnoyarsk and Altay krais, Mordvin and Bashkir ASSR, and the Far East. At one time, the plant was cultivated for opium (in the Asiatic zone) as well as for its oil, but at present its use as a narcotic has been virtually eliminated in these areas and the use of opium is restricted to medicinal purposes.

Peanuts

The peanut, the soybean, and the castor oil plants are oleaginous plants which have recently been introduced into the Soviet Union and subsequently developed on a large scale. The peanut is cultivated in south and southeast USSR: in Ukrainian SSR, the Caucasus (Georgia 4,100 hectares, Azerbaydzhan 4,000 hectares, Armenia). and in Tadzhik and Turkmen SSR. Although the plant was introduced only about 20 years ago, by 1938 there were 22,700 hectares in peanuts. Its cultivation has now been extended to include the Transcaucasus, Krasnodar Kray, Uzbek SSR, etc. Selective breeding of

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imported varieties has been undertaken to develop strains best suited to the new conditions. The following types have been developed: Spagnolo [possibly Ispanets-Spanish] No 46/2, 96, 162, 94, and 32/76, and the early maturing No 0344; Valencia No 0433 and 112; Tashkent No 1; No 104, 107, 123, 153, Aurora, Java, etc. The results of this experimental work have been rather satisfactory and yields have averaged 1,000 to 1,200 kilograms or more per hectare, with an oil content of 40-59.5 percent. As a result of the sharp decrease in output during the war, it is difficult to assess the present output.

Soybeans

Soybeans, grown primarily in the Far East and recently cultivated with some success in the Transcaucasus, Ordzhonikidze, Ukraine, and even farther north, did not suffer much from the war. The soybean acreage rose from 170,000 hectares in 1933 to 220,000 hectares in 1946 and 274,000 hectares in 1947.

Taking 1,000 kilograms per hectare as the average unit yield (experimentally, double this amount has been obtained as a maximum), the total current seed production approximates 200,000 metric tons. Selective breeding, begun in 1930, has been directed toward development of early-maturing varieties which will permit extension of soybean cultivation farther north. Elite types include: Krushula, Steppe, Yechov Precoco [possibly Skorospelost'-early maturing] 1153, Harbin No 7, 8, and 118, Staro-Ukrainka and Sineinikovo Precoco [possibly Skorospelost'-early maturing].

Castor Oil Plants

The castor oil plants *Ricinus communis persicus* and *Ricinus communis sanguineus* have developed along lines similar to the soybean. The most widespread types are Kruglik 5, Donsk, 172/1, Caucasian, Tashkent 351, 3D, and Sanguigno Precoco [possibly sanguineus Skorospelost'-early-maturing sanguineus]. Generally, the early-maturing varieties are inferior to Italian varieties, including some developed by the author. The oil content of Soviet varieties ranges from 40 to 50 percent. Cultivation of the castor oil plant is concentrated in the southern and eastern regions: the Ukraine beyond the Dnepr, the northern Caucasus, and the Kazakh, Kirgiz, Tadzhik, Uzbek, and Turkmen SSR. Despite the recent introduction of the plant into the Soviet Union, by 1941 the USSR has begun to export castor oil and, at present, is second only to India in area under cultivation. In 1937, 237,900 hectares were in castor oil plants. During the war, there was a sizable decrease in acreage, and in 1947 only 50,000 hectares were in castor oil plants. It is doubtful that this acreage was increased in 1948 as called for by the plan. Unit production of seed varies from 1,000 to 1,800 kilograms per hectare. Consequently, the total Soviet output must be set at a minimum of 50,000 metric tons.

Other Oleaginous Plants

The perilla (beefsteak plant), lallemantia (mint family), sesame, and other oleaginous plants are also considered important despite their cultivation on a relatively small scale.

Although the perilla is indigenous to the Soviet Far East, the value of its seed (oil content varying from 44-47 percent to as high as 54 percent) was scarcely appreciated before 1933. This labiate plant has been cultivated in the Ukraine, Krasnodar Kray, Ordzhonikidze, and the Transcaucasus. Selective breeding has produced such improved strains as No 30, 141, 501, 1120, Novita [possibly Novinka - novelty], Produktiva [possibly Plodovitost' - fertility], Oriente [possibly Vostok - east], etc.

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The lallemantia (mint family), known since ancient times in Armenia and Iran, is indigenous to southeastern Russia, where it now grows wild. For a short period (1890 - 1900), lallemantia seemed to be a rival of the sunflower, but serious attacks on the plant by weevils and the dodder relegated it to a minor position. At its peak, cultivation of lallemantia extended into the Transcaucasus, Kuban, Crimea, and as far north as Kursk and Voronezh oblasts, but its unstable yield and the lack of markets to absorb its output limited its distribution. Cultivation fell off from about 1925 and continued falling through 1936 - 1937. By 1938, only 16,000 hectares were under cultivation in Krasnodar Kray and the southern Caucasus. Experiments have demonstrated the possibility of introducing this labiate plant almost everywhere, even as far north as Leningrad, Ivanovo, and Chuvash ASSR. A capacity for early maturing, extreme adaptability, and increased immunity to disease combine to make the cultivation of lallemantia possible even in the north.

Podoba conducted the first (in Russia) studies on lallemantia and its selective breeding in 1877. In 1928, the Don Plant Selection Station isolated four elite strains of the plant: No 2, 5/9277, 22, and 24. According to Vakulin, there are at least five varieties of the species: Lallemantia iberica-subrosca, alba, angustifolia, sulphurea (C. Koch), and vulgaris, with oil content of the seed varying from 29.56 percent to 32.03 percent. Shaparov indicates a wider range for oil content, 24-38 percent. The oil dries better than linseed oil and since 1939 has been utilized in the preparation of linoleum. Lallemantia's greatest defect is a low and unstable unit yield, normally between 200 and 600 kilograms per hectare and never exceeding 1,400 kilograms. In 1941, the plant was cultivated on 29,500 hectares in the following areas: Krasnodar Kray 23,000 hectares, Rostov Oblast 4,000, Stavropol Kray 2,000, and Saratov Oblast 500. Recently, lallemantia has been introduced into Azerbaydzhan SSR. In the postwar period, the production of lallemantia has been reduced, but not neglected.

Sesame (especially the varieties asiaticum and palestinicum) has also been cultivated in Russian Turkestan since ancient times. The expansion of cotton in the last 20 years has driven sesame from the irrigated areas and has made it a dry crop. The area in sesame is concentrated in Uzbek SSR and the southern Caucasus and varies from year to year according to the demand for the oil, which is used primarily in pastries. In 1931, 100,000 hectares were in sesame, but the acreage decreased to 61,300 hectares in 1938 and was even lower during the war years. The plant offers fine possibilities for selective breeding, and several improved strains have been developed. These include the Tashkent 122, the Don 23, No 2058, the VNIIMK 889, 1, 6, and 81.

The safflower (*Carthamus tinctorius*) is generally found in the same geographic area as sesame: the northern Caucasus, the Kazakh, Kirgiz, Tadzhik, and Uzbek SSR, and farther north in Ukrainian SSR and in the central steppe regions. Although safflower has been known and used for many years, large-scale utilization of the plant was undertaken only after 1930. Genetic improvement has been conducted, and the strains 29/1 and 29/19 (at the Don Plant Selection Station), Tashkent 51, and Krasnokutskaya have been developed. The present cultivated area of 35,500 hectares seems almost negligible. Unit production of 200-1,500 kilograms per hectare, although low, is nevertheless higher than sunflower in the driest regions. One of the safflower's greatest advantages is its adaptability to arid conditions.

Coriander (*Coriandrum sativum*), found in central and southern Russia and the northern Caucasus, is also utilized for its oil.

In 1939, chufa (*Cyperus esculentes*) was grown on 1,350 hectares in the northern Caucasus. Unit yield was 1,500 to 4,500 kilograms per hectare.

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Among oleiferous trees, the walnut is most important because of the large area over which it grows. Cultivated or wild, it is found in the Ukraine, the Crimea, the Caucasus, and throughout Central Asia, with its greatest concentration in the Fergana watershed. Seslavin and Alekseyev determined the distribution of Asiatic walnut orchards for 1936 as follows: Kirgiz SSR 43,848 hectares, Tadzhik SSR 40,000, Azerbaydzhan SSR 3,000, Kazakh SSR 2,000, Uzbek SSR 300, Turkmen SSR 100, and Abkhazian ASSR 10,000, a total of 99,248 hectares.

Since 1936, there have been fluctuations in walnut acreage, with prewar increases canceled out by wartime losses. As a result, the present Soviet walnut acreage is probably 100,000 or more hectares. Oil content of walnuts is very high (56 to 73 percent), but production varies from year to year.

Cultivation of olive trees is limited to regions with Mediterranean climates (southern shore of the Crimea, Transcaucasus), and the use of olive oil is scarcely known. Valuable local strains include the Nikitskiy Sad No 1, 3, 5, 6, 7, the Naglyskiy, the Lomashenskiy, the Novo-Athos, etc.

The distribution of the almond tree is quite different from that of the walnut tree since the former is found on a large scale in the Central Asiatic republics, but is almost nonexistent in the Crimea or the Transcaucasus.

In 1930 - 1931, two varieties of the tung tree (*Aleurites Fordii* and *Aleurites cordata*) were introduced into the subtropical regions of Georgian SSR. By 1939, the tung tree grew on 15,000 hectares. Selective breeding of the tung tree has recently been undertaken, and the following improved strain has been developed: VIR No 2 (*Aleurites Fordii*), with a 50 percent oil content. *Aleurites cordata* is richer in oil content, with 68 percent.

Conclusions

If wartime damage to flax, peanuts, sesame, perilla, lallemantia, and other minor oleaginous plants is taken into account, the current production of vegetable oils is relatively favorable. At present, the total area in oleaginous plants is barely 1,100,000 hectares. Selective breeding of the crucifers, labiates, and poppy is continuing, with emphasis on early-maturing, frost-, drought-, and parasite-resistant varieties. Attempts are also being made to adapt these plants to mechanized cultivation, to husk them more easily, and to increase their oil content. Other experiments seek to adapt the plants to various ecological conditions and to solve technical problems in the organization of work (mechanization, crop rotation, manuring, etc.). A system of rewards for attainment of high cultivation and yield quotas has also been set up.

In 1947, total production of vegetable oil was 124 percent of the 1946 figure, which, in turn, was considerably greater than the 1945 total. Based on the figures already presented for individual crops, total Soviet output of oil seeds in 1948 is estimated as about 4,500,000 metric tons, distributed as follows: sunflower 2,713,600 metric tons, cotton 1,071,000, mustard 200,000, soybeans 200,000, flax 104,160, camelina 100,000, castor oil plants 50,000, colza 50,000, hemp 12,500, and minor crops 50,000, a total of 4,551,260 metric tons.

If the average oil yield of the plants listed above is considered to be about 15 percent of the seed yield, the total vegetable oil production in 1948 would be about 675,000 metric tons, which is lower than the prewar total. Varon's investigations have resulted in the same conclusion. While not yet satisfying domestic needs, the Soviet Union has gone a long way toward making up its fat and oil deficiencies. If the present rate of increase in vegetable

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oils is maintained, by the end of the present Five-Year Plan the Soviet Union may be able to export a certain amount of seeds and seed oils, with possible repercussions on the international market.

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